Space Weather Technical Forecast

Issued on Thursday, 04 November 2021 at 00:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of further M-class flares. G1/Minor or G2/Moderate geomagnetic storms expected on day 1 and 2 (4th and 5th), and slight chance of further G3/Strong geomagnetic storms early day 1.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are two sunspot regions on the visible disc with observed solar activity returning to Low over the past 24 hours. The peak flare was an LDE C5.2 from AR2891 at 03/2117 UTC. AR2891 (Cai/Beta-Delta) has developed a delta spot in its trailing penumbra, however there has been some slight reduction in overall size, and decay in its lead/trailer spots. AR2893 (Hsx/Alpha) in the northeast quadrant appears stable with very little recent activity. A CME may have left the sun associated with the C5 flare, this will be analysed once data becomes available.
The CME which was observed leaving the Sun early on the 2nd November arrived at L1 DSCOVR around 03/1930 UTC and Earth around 03/2000 UTC.
A further CME was observed directed towards the southwest launched from near AR2887 after midday UTC on 2nd. This was modelled and misses Earth. Two further CMEs were observed, one late on 2nd from beyond the west limb, and another during early hours UTC of 3rd from beyond the east limb. Neither of these CMEs is expected to be Earth directed.

Solar Wind / Geomagnetic Activity: Solar wind parameters were indicating a waning connection to the high speed stream from coronal hole 16. However, following the arrival of the CME they increased to near 750 km/s. Density had been stable and near average, but increased to a maximum of 28 ppcc following the CME, before easing back to around 10 ppcc. Total IMF, Bt, was weak, in the range 2-5 nT, then increased in response to the CME to a maximum of 24 nT at 03/2038 UTC, before easing back to around 20 nT. The north-south component, Bz fluctuated weakly before a strong negative dive post-CME to a value of -16 nT, there was no extended negative Bz observed with some strong fluctuations into positive values observed, the highest being +14 nT at 03/2334 UTC. Phi angle was mostly positive (away from the sun) with only brief negative (towards the sun) fluctuations. Geomagnetic activity was Quiet to Unsettled until the 1800-2100 UTC interval became Active (Kp4) and the 2100-2359 UTC interval which observed a G3 Strong geomagnetic storm.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained slightly elevated but below the S1 level, before briefly exceeding S1 level between 03/2055 UTC and 03/2105 UTC. The high energy electron flux (greater than 2 MeV) was mainly at background or moderate levels with the associated 24-hour electron fluence below the Active (1e8 integrated pfu) threshold, and with 4.96e6 integrated pfu recorded at 03/2359 UTC.

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Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain mainly low through the next four days, but with a continuing slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: Geomagnetic activity is likely to be enhanced during day 1 (4th Nov) possibly extending into the first part of day 2 (5th Nov) with further Minor to Moderate geomagnetic storms (Kp5/6 G1/2) expected and a slight chance of Strong storms (Kp7/G3) early on day 1. Later on day 2 into day 3 (5th and 6th) geomagnetic activity is likely to reduce, though confidence is low due to uncertainties regarding the size and likely duration of the magnetic cloud associated with the CME. So on day 3 and 4 (6th and 7th) mainly Quiet to Unsettled with a slight chance of Active intervals is most likely.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain below the S1 minor storm level with just a slight chance of exceedance on days 1 and 2 (4th and 5th). The high energy electron flux (greater than 2 MeV) is forecast to be at mainly background to moderate levels, with an increasing chance of reaching sustained moderate or occasionally high levels through the period especially towards days 3 and 4 (6th and 7th). Corresponding 24 hour electron fluence values are expected to remain below the Active (1e8 integrated pfu) level during days 1 and 2 (4th and 5th), although a rising trend is likely after the effects of the CME wane through days 3 and 4 (6th and 7th).

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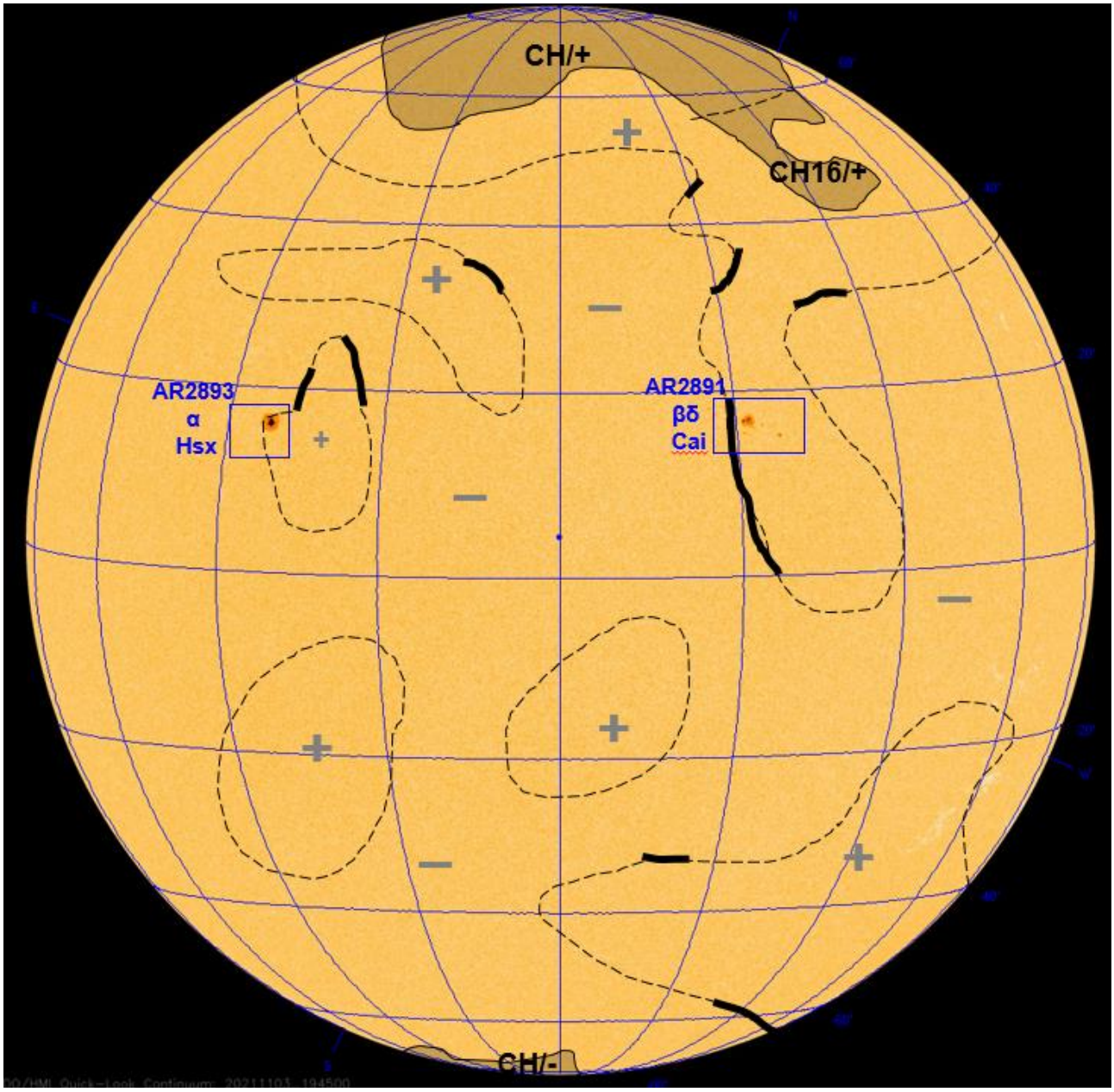
Figure 1. Solar Analysis Valid 03/2000UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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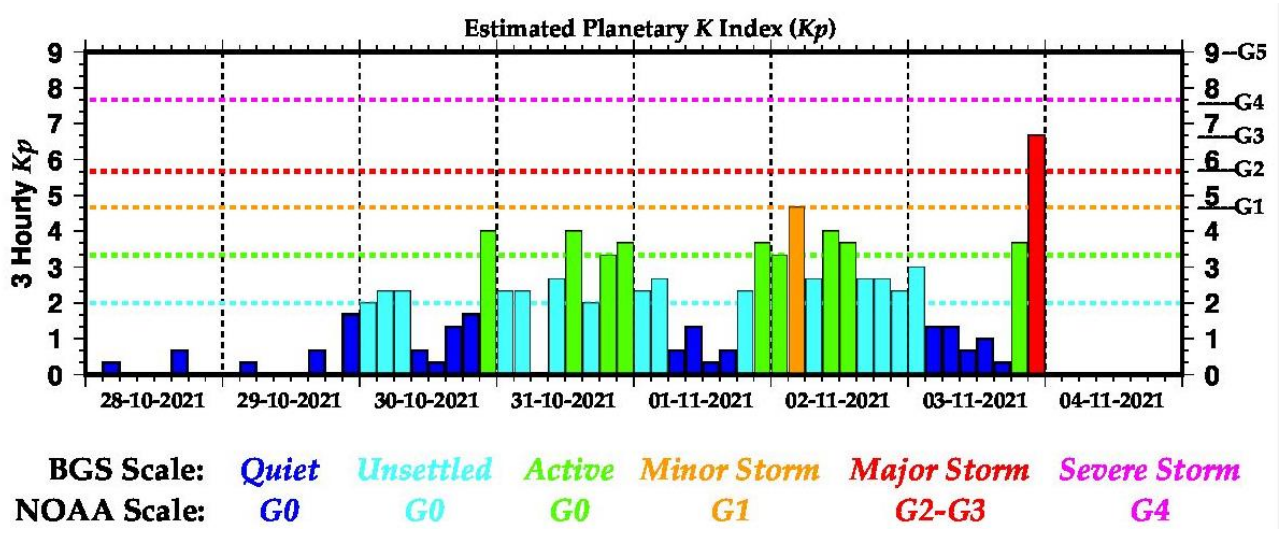
Geomagnetic Storms:

The solar wind currently remains strong following the arrival of the CME, around 750 km/s.
Further Minor or Moderate geomagnetic storms are expected on days 1 and 2 (4th and 5th) with a small chance of a G3 Strong storm, most probable at first. These disturbed geomagnetic conditions are likely to persist well into day 2 (5th) before subsiding.
The previously mentioned couple of possible glancing blows from CMEs from 31st October and 1st November are likely to be swept up in the 2nd November CME.
A CME may have left the Sun associated with the C5 flare, this will be analysed once imagery becomes available.
No other coronal hole influences are expected, leading a decreasing risk of geomagnetic storms after day 2.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	90	70	20	10
Strong	G3	Yes	20	10	1	1
Severe	G4	No	5	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections. Nil

Figure 2: BGS Estimated Planetary K index (Kp) shows the G3 late on the 3rd (UTC day).



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Radio Blackouts - X-Ray Flares:

Solar activity is expected to be mainly low, with an ongoing chance of C-class flare activity and a slight chance of M-class flares. The main risk region is AR2891 (Cai/Beta-Delta), which gave a long duration C5 flare peaking around 04/2117 UTC. AR2887 (Hsx/Alpha) has rotated off the visible disk around the southwest limb.
AR2893 (Hsx/Alpha) in the northeast quadrant appears to be relatively benign with no real signs of recent significant development.
A new potential active region is evident at the southeast limb of STEREO-A imagery, and will be monitored as it reaches the limb of the visible disc by the end of the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	2	2	2	2

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is now below S1/Minor storm levels. However, further minor enhancements from significant flaring remain possible.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
High energy electrons (greater than 2MeV) are currently at background to moderate levels. The CME arrival is likely to lead to some disruption of the radiation belts and adds greater uncertainty to the forecast. A rising trend from current values is tentatively anticipated following the CME effects on days 3 and 4 (6th and 7th), but with low confidence.
Electron fluence values are forecast to remain below the Active (1e8 integrated fluence) threshold through the first two days with a slight chance of rising above during days 3 and 4 (6th and 7th).

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	10	10	20	20
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	2

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